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NATURAL FORCE.

A NEW VIEW.

BY

JOHN N. VAN LEW,

RICHMOND, VA.

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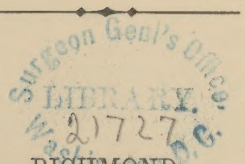

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PREFACE.

THE author has endeavored to render the theory submitted concise and comprehensive. It is a practical reversion of the present received views of natural force as sustained by the acuteness and ability of many profound men. It is therefore to be hoped the public will give the subject deliberate and impartial consideration, before pronouncing judgment.

NATURAL FORCE.

STATIC DEVELOPMENT.

Inorganic forces, as at present set forth by the teachings of learned men, are obscure and metaphysical, and cannot be clearly understood as agreeing with the great fundamental doctrine of the conservation of force, without multiplying speculation to an extent that is not consistent with the great truths of nature.

Surmounting a difficulty by a resort to speculation is, under any circumstances, a dangerous experiment. Men adopt certain theories, biased by early teachings, and these theories rule and control the man, to the exclusion of all other views upon the respective subjects: even facts must give way to the favored theory. This pertinacity of purpose, this devotion to a single idea, must lead into grave errors: hence, we observe many persons entertaining widely different views in regard to the same natural facts and phenomena. The book of nature is open to all who are willing to read, and rightly interpret, the varied and wonderful facts displayed to the searching inquirer.

In regard to Natural Force, we are about propounding a new view. This view is in radical oppo-

sition to present received theories, based, as it is, upon the presumption that there is but one force in nature, which is of course a fundamental force. The late Michael Faraday more than once advanced the same idea. Mr. Faraday was a man of great depth and originality of thought, devoted to truth and opposed to speculation, basing his opinion upon facts, was even then cautious and diffident in advancing them. After a long life devoted to study, Mr. Faraday has recorded his opinion that there is but one force in nature; he says, "The long and constant persuasion that all the forces of nature are mutually dependent, having one common origin, or rather being different manifestations of one fundamental power, has made me often think upon the possibility of establishing by experiment a connection between gravity and electricity."

We have for years been persuaded that there is but one force in nature, and that all the varied conditions of force recognized by science as distinct, are each in turn respective conditions of this great fundamental force. The allegiance that all forces owe to matter, arrested the attention of our mind, when we first ventured a thought upon the subject: the intimate union existing between matter and force, urged us to designate natural force as the integral attribute of matter; but there was a vagueness about this definition that was to us, upon further thought, unsatisfactory. We then concluded that matter and force were identical; but even then, we could not realize the fact that natural force and actual matter were the same—that the substance and the power were identi-

cal. It was only after a further lapse of time, we were convinced that matter, tangible matter,* was force; the *great fundamental static force of nature.*

We are fully aware that the view we are here putting forth is bold and new, and in direct opposition to the present views and teachings of the savans of the world. There is, however, one exception, as the views propounded by the late lamented Michael Faraday agree with ours, at least in part. Much, therefore, remains to be said by us, and must be said, to sustain and uphold a view so bold, and differing so widely from the present popular and prevailing theories.

We discard *in toto* the doctrine of the immateriality of natural force. Can the ship plough her majestic way athwart the broad and stormy ocean, through the medium of a power possessing no material existence? Can the railway car traverse vast continents with almost lightning rapidity, through the medium of a power possessing no material existence? Can the wonderful results of machinery, as applied to mechanics of the present day, be the work of a power possessing no material existence?

Force must be material; and if material, is it not matter? Mr. Faraday in his experimental researches in electricity (second vol., page 290), says, "All our perceptions and knowledge of the atom, and even our fancy, is limited to the idea of its powers. What thought remains on which to hang the imagination

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*We adopt this language to give force to our expression. We mean all matter; all that is material.

of an *a*, independent of the acknowledged forces? A mind just entering on the subject may consider it difficult to think of the powers of matter independent of a separate something to be called *the matter;* but it is certainly far more difficult, and indeed impossible, to think or imagine that matter independent of the powers? Now, the powers we know and recognize in every phenomenon of the creation, the abstract matter in none. Why then assume the existence of that of which we are ignorant, which we cannot conceive, and for which there is no philosophical necessity?" Mr. Faraday actually denies the existence of abstract matter; virtually holding, that what we call matter is in reality force, although not expressed, evidently indicating the identity of matter and force.

The great argument we have to combat is the very popular teaching, that all motion is force. Some of the most brilliant intellects are advancing this view. Therefore, feeling conscious that our task is herculean, we must prepare to meet it, with the armor of truth buckled on, having the breastplate of facts ever present.

We propose by a lucid interpretation and our own explanation of temperature, to meet and surmount this difficulty.

We must, as it were, disembody our minds from the fettering effects of sublunary surroundings, and view this great subject as though we were denizens of some other sphere; not too remote, however, for we wish to examine it with the exactness and detail of a microscopic eye. We must consider the fact that

it is only through matter we are cognizant of any condition or phenomenon of nature: action must be material, or there can be no impression made upon our senses. Temperature is a subject worthy the most profound consideration, but it has not received that consideration; its wonderful attributes have therefore never been appreciated. Certain degrees of temperature have been treated, and volumes written; but the views were partial, resulting from limited premises, and the conclusions full of speculations and erroneous deductions.

We propose considering the question as a whole. All our estimates, all our conclusions, must be accomplished through the study of matter: we must note the respective conditions matter assumes, subjected to certain degrees of temperature; we must at the same time remember that the scale of temperature is without limit, or that we have no knowledge of a limit and can conceive none. We hold that heat, under all conditions and circumstances, is only relative; in other words, that it is heat because it is a certain number of degrees higher temperature than contiguous surrounding matter. The temperature of Zero, Fahrenheit's thermometer, is heat compared with a temperature fifty degrees below that point, and the temperature of boiling water is very cold, compared with that of molten iron. To illustrate our meaning, we will cite the effect of change of temperature upon matter below the Zero point, Fahrenheit's thermometer. About the year 1860, there appeared in a number of the *Canadian Journal of Industry and Science*, some interesting facts, as observed in Rice

Lake, C. W., by J. H. Dumble, C. E.: "A bridge of the Colbourg and Peterborough railway runs through this lake, and in the Southern States, or in a mild climate, it would have answered every purpose, but with the expansion of the ice on this lake in such a cold climate, it has become a complete wreck. Glare ice is that which is smooth on the surface: it has been found that such ice, when acted upon by the midday sun, is immediately set in motion by expansion, and it generally sets in towards the shore. Sometimes this motion is very gradual, and accompanied with a slight cracking noise, sometimes it is rapid and violent, and accompanied by a succession of vigorous jerks, and a hollow rumbling sound, seemingly from under the ice, while at intervals there occur loud and sharp reports like those of cannon. Sometimes the ice expands several feet on the shore without any fissures being created in the lake. This is caused by a temperature of the atmosphere higher than that which previously existed. If the thermometer indicates a temperature of 30° below Zero, and then suddenly rises to Zero, an expansion of the ice results. The force with which the ice expands depends entirely on the extent of the change of temperature. The most forcible movements of the ice occur previous to rain storms. A sudden rise of 20° in temperature produces violent expansion. Strong oak piles in the bridge, which would not bend, were cracked and splintered by the ice expansion; heavy cap timbers of pine were snapped like reeds, and heavy iron rails were curved and doubled up, as if put in a huge press. Trees growing on the shore

have been torn up by the roots, by the ice expansion, and boulders weighing several tons have been lifted from the shore and forced into the bridge timbers. On one occasion, the ice expanded no less than six feet along the whole shore. A uniform temperature of the atmosphere neither causes expansion or contraction of the ice: it matters not whether the temperature is high or low, no movement of any kind takes place."

These facts, beyond question speak for themselves. Iron girders on bridges and other structures, we know are often fractured by sudden and violent changes of temperature much below the freezing point of water. These effects are as much the result of heat as the power developed by the temperature of a blast furnace acting upon contiguous matter. Any temperature must be recognized as heat when compared with another temperature a few degrees below it; hence, we must recognize heat at all points on the scale of temperature.

The great question now arises of the motion of heat, so ingeniously and elaborately set forth amid a network of speculation, by the leading savans of the world.

We here assert as a fact, that this motion is all attributable to a change of temperature. The molecular motion known to take place in matter subjected to a high temperature, is, we hold, the result of a changing condition, and is essential. In this motion matter is accommodating itself to an altered temperature—a state of transition from the condition peculiar to one temperature to the condition peculiar to another temperature, higher or lower on the scale.

But let the temperature be uniform, and remain so for some time, and as soon as matter has become adapted to this uniform temperature, motion ceases. If this temperature be above the boiling point of water, water must assume the condition of vapour, and if below the freezing point, it must assume the solid condition (become ice), before it can be in either case quiescent. For example, we cite the case already stated, observed in Rice Lake, C. W.: "A uniform temperature of the atmosphere neither causes expansion or contraction of the ice. It matters not whether the temperature be higher or lower, no movement of any kind takes place."

We are told by Professor W. R. Grove, "that nature gives us no evidence of absolute rest; that all matter, as far as we can ascertain, is ever in motion, not only in masses, as with the planetary spheres, but also molecularly, or throughout its most intimate structure. Thus every alteration of temperature produces a molecular change throughout the whole substance heated or cooled," &c.

The Professor says truly, any alteration of temperature produces a molecular change throughout the whole substance, but the Professor appears to have overlooked the fact that a uniform temperature arrests molecular motion. All this motion in matter, that Professor Grove alludes to, is the result of a changing temperature—matter adapting itself to the ever-varying temperature of our atmosphere. We must remember that all matter assumes a distinct condition for every degree, or part of a degree, of temperature. In illustration, we cite water in its three

distinctive conditions, viz: Solid, Liquid, and Vapor. Ice, or the solid condition, is a normal or permanent condition at a certain temperature; the liquid state is a normal or permanent condition at a certain temperature; and the vapor state is a normal or permanent condition at a certain temperature.

Finally, we observe the three distinct temperatures require water to adopt three distinct conditions. The requirements of temperature are imperative; water *must* assume these three conditions at the respective temperatures: the Almighty Architect of the universe has ordered it thus.

Ought man, the puny denizen of the little planet Earth, to question this great work, and say that one of these three distinct temperatures is a great force, and the other two are not? Yet such is the teaching of the Dynamic theory of Heat.

As already stated, matter (force) has a respective condition, adapted severally to every degree of temperature. If, however, this were not the case, and all matter were alike affected by varying temperature, we would have no available evolution of force resulting from the application of a high temperature to matter. But the wisdom of an inscrutable Providence has ordained it otherwise: different varieties of matter assume widely different conditions subjected to the same degree of temperature. The temperature that vaporises water, does not perceptibly affect iron, copper, and other metals. Man has turned this peculiar characteristic of matter to the most valuable account: thus it is that the mighty force of steam is rendered available.

In the steam boiler we have water in the form of vapor, and at the same time the iron composing the boiler not perceptibly affected; yet the terrific force which results from the compression of the elastic matter steam in the boiler is comparatively harmless, for the boiler, when properly constructed and carefully managed, never gives way. The force of iron, the iron boiler restrains in subjection to the will of man, the force of water, identical in character.

By a sufficient elevation of temperature, the iron boiler would become a liquid, and finally, by a still greater elevation of temperature, a vapor, and it would remain a vapor were this high temperature permanent; at this high temperature the vapor condition of iron would be a normal condition, as much as the solid condition is normal at the temperature of our atmosphere.

The arrest of motion in a moving body by counter motion producing rest, we are told, is annihilation of force, and therefore cannot occur but that a new force now ensues, the exponent of which, instead of being visible motion is heat. Force is regarded as converted into heat upon two bodies impinging upon each other. The same is said of heat, the result of friction on the axles of railroad cars and coaches, and the journals of steam engines, or friction in any form.

We are told also that heat when applied to mechanical purposes is converted into force, and that all motion resulting from the application of heat is a conversion of heat into force.

We cannot in any way sustain these conclusions,

for the reason that we cannot reconcile to our philosophy the deduction that one degree of temperature is a force, and another is not.

Prof. Tyndall says, "Heat itself is molecular motion; it is an oscillation of ultimate particles; but such particles, when closely grouped, cannot oscillate without communication of motion from one to the other." And again, he says, "The ideas of the most well-informed philosophers are as yet uncertain regarding the exact nature of the motion of heat; but the great point is at present to regard it as motion of *some kind*." Dr. Mayer says, he is "*rather inclined* to *infer*, that before it can become heat, motion, whether simple or vibratory, as in the case of light and radiant heat, &c., must cease to exist as motion;" and yet Dr. Mayer says motion cannot be annihilated. Tyndall endorses Mayer, and speaks of him in the highest terms as a great philosopher, although they differ radically in propounding their theory.

Prof. Grove tells us, "Heat thus viewed is motion; and this molecular motion we may readily change into motion of masses, or motion in its most ordinary or palpable form." In the next sentence he tells us there must be an alternate action of *heat and cold*. In other words, the Professor tells us one degree of temperature is a force, and yet at the same time it is not a force unless the circumambient air is at a temperature many degrees lower. The law of Carnot, as stated by Prof. Helmholtz, is as follows: "Only when heat passes from a warmer to a colder body, and even then only partially, can it be converted into mechanical work." How is it that according to the law thus

stated, it is only partial when we are continually assured by the most prominent supporters of the mechanical or dynamical theory of heat, that heat is *converted into force*, the expression partial not being admitted?

We might state other discrepancies and contradictory speculations advanced in support of this theory, but it is our purpose to remark upon the opinions of other men only to the extent that will give prominence to our own. It must be borne in mind that we make but ONE *supposition* in this connection, and that is, that matter and force are identical.

In recognizing matter as force, we endorse the principle of the conservation of force in its fullest sense, for in the known indestructibility of matter, we recognize the conservation of force—which principle the most profound savans tell us no theory, to be acceptable, can ignore or contradict. To discard this profound principle, a distinguished writer says: We might as well accept our limited horizon as the limit of the world.

NATURAL FORCE

DYNAMIC DEVELOPMENT.

In treating upon a subject so evanescent and apparently so immaterial, and yet so potent, so powerful and so all-prevailing, as electricity, we should by all means avoid abstractions, which with such a subject, can only be accomplished by avoiding speculation. The beacon light of *truth* and *fact* should guide us to avoid the shoals of fallacy. Speculation, when not sustained by a sequence of the most profound fundamental facts, must, without fail, result in erroneous deductions. The most trivial contradiction or anomaly should overturn any theory upon a subject like this, unless facts can be adduced to prove the irregularity only apparent.

The dual property of electricity has been hypothetically accounted for by various theories, of which the most prominent and most worthy of note, are those of Franklin and Du Fay. The latter view, like Dalton's attomic theory, has been generally received, as nothing better offered, and it was, like Dalton's theory, excellent for explanatory purposes. But of late, people have learned to take an intermediate view, i. e., to believe partially in both theories, blending them, as it were, without adopting either. This is owing, no doubt, to an every

day acquaintance with the remarkable agent, through the wonder-working telegraph that is everywhere in our land, and throughout the world. The fact is noteworthy that no theory has been advanced by savans of the present age upon this interesting point.

The late Michael Faraday, perhaps the most profound fundamental thinker upon the subject of electricity, that ever lived, attributes the dualities to one common origin. He says in his Experimental Researches, Art. 3,329: "As to the independent existence of the two powers, how is it that they cannot be shown separately? And again, Art. 3,324: "There is no known case of one form or part of a dual power existing otherwise than with and in dependence on the other which then exists simultaneously to an equivalent, i. e., an equal degree."

Mr. Faraday, it appears, was firm in the belief that the dualities, although apparently distinct, were in reality the same force. Dual action is evidently a fundamental characteristic of electricity or magnetism and it must be viewed as a dual acting force in all its relations and connections. And why should not this dual character be essential to perfection in this great dynamic force of nature? Do we not find it prevailing and controling all the works of nature of which we have cognizance? In the material world we find duality prevailing to an unlimited extent; the existence and maintenance of the animal and vegetable kingdom depend solely upon it. Our senses, as far as we can perceive, are absolutely dual: this is particularly the case with our visual organism. In music duality is essential to harmony. In the

works of art duality is essential. James Watt perfected the steam engine, and immortalized himself when he invented the double-acting cylinder. Investigating closely the laws of nature and the works of art, we find duality prevailing in the perfection of the former, and essential to fullness and completeness of purpose in the latter.

The antithetical property of electricity, or the fact that the dualities are respectively to themselves repelling, is a remarkable feature in electric phenomena, and in the view we are about submitting worthy special consideration.

No one can question the fact that motion, intense motion, is a fundamental property of electricity. The supposition or presumption we make, and the only one in this connection, is that electricity is eminently a dynamic force, and this is the sequence to the supposition that matter is force as shown in our treatise on static force. Inasmuch as we say matter is static force, we say also electricity is dynamic force. As the fundamental condition of the former is rest, so the fundamental condition of the latter is motion. The substance or matter and the power are the same with this difference: one is the static, the other the dynamic development of one great force, which we recognize in and about us as matter. Thus we consider electricity as the dynamic condition or development of matter. To take as far as possible a just and impartial view of this interesting subject, we must consider our telluric surroundings. We live and move and have our being in the midst of matter; our bodies, the finite abode of life, are matter; all that we see, and feel, and hear, and know, or can in

any way communicate, must be through the direct instrumentality of matter; in fine, our very existence is matter, our life is matter. Are we not dwelling upon the bottom of a vast atmospheric ocean, the depth of which we may conjecture but cannot fathom. It is a fact too well known to need recital here, that the direct contact of the atmosphere is absolutely essential to all animal and vegetable vitality. Under any circumstances we must consider natural force, whether static or dynamic, as a question of matter even in its cosmical relations. But upon the face of our earth we have a dense and palpable atmosphere, by and through which all our movements of any character must be made, and by which through the medium of evaporation the waters of our globe are from time to time lifted up to regions far above our surface abodes, and there held in the palpable form of clouds and vapour, until the law of nature orders their precipitation in the form of rain, hail or snow. All this interesting meteorological phenomena are the result of the direct action of matter upon matter through the changing condition of static force and the partial development of dynamic force.

Furthermore, how can this action be aught but matter upon matter, when our whole globe and all its surroundings are without the smallest void space, but matter, matter everywhere?

The disturbances in our atmosphere are on a stupendous scale, the power enormous; witness the gales of the temperate zone, the tornadoes and hurricanes of the tropics. No one can deny that all this great development of power is matter, when it is remem-

bered that every inch square sustains a superincumbent weight of over 32 lbs. Can the force in this case be aught but air when we remember it permeates every crevice with a force or power, as we have already stated, of at least 32 lbs. to the square inch?

The dynamic development of this atmosphere, this matter, or static force, scintillates for an instant athwart a dark heaving cloud, and the blackest night is a blaze of glory, but it is only for an instant, as a union of the dualities at once restores the static condition, lightning flash follows lightning flash in rapid succession, presenting a scene of grandeur beautiful to contemplate. But this is not all: the purifying and vivifying effect of thunder storms upon the atmosphere is always apparent.

The sun, the great disturber, induces a condition somewhat analogous to magnetic polarity in the atmosphere, enabling it to hold in suspension vast amounts of aqueous vapour, increasing until dense clouds of enormous weight are formed, finally condensation commences, the dualities rapidly unite, and rain descends in torrents. No one can say that the sun is not the cause of this great atmospheric disturbance, this wonderful evolution of force, static and dynamic. If the above facts are admitted, what can this force be but matter, and the motion but the result of the sun's disturbing action upon this matter, the matter of the atmosphere assuming varied conditions subjected to varied degrees of temperature?

The magnetic influence of the sun has undoubtedly much to do with the formation of clouds and the retention of aqueous vapour in suspension. A person

of no less note than Mr. Faraday expresses the positive conviction that matter owes its identity to electric ties. The globe-encircling ocean he has proved to be a vast reservoir of electric power. Hear his remarks upon the electric decomposition of a grain of water, Expr. Researches, Art. 855 and 856:

"Considering this close and two-fold relation, namely, that without decomposition transmission of electricity does not occur, and that for a given definite quantity of electricity passed, an equal definite and constant quantity of water or other matter is decomposed; considering also that the agent, which is electricity, is simply employed in overcoming electrical powers in the body subjected to its action, it seems a probable and almost natural consequence that the quantity which passes is the equivalent of, and therefore equal to, that of the particles separated; i. e., that if the electrical power which holds the elements of a grain of water in combination, or which makes a grain of oxygen and hydrogen in the right proportions unite into water, when they are made to combine, could be thrown into the condition of a current, it would exactly equal the current required for the separation of that grain of water into its elements again. This view of the subject gives an almost overwhelming idea of the extraordinary quantity or degree of electric power which naturally belongs to the particles of matter, but it is not inconsistent in the slightest degree with the facts that can be brought to bear on this point."

Let us pause here, and reflect upon the enormous electric power that Mr. Faraday says naturally be-

longs to a grain of matter. It is evident from his mode of expression that Mr. Faraday considers this electric power as not alone belonging to water, but to all matter; but in this connection we will alone consider water.*

This is not a speculation of Mr. Faraday's, but a plain unvarnished *fact;* the result of his untiring research, a great natural truth that speaks for itself. What an enormous, what an overwhelming amount of electric power belongs to the vast ocean, the finite mind cannot comprehend such majestic power. We know the quantity belonging to a few gallons of water would suffice to rend our globe. What is all this electric power doing in matter, how is it there, and why is it there? Will the savans of the world tell us? We have yet to see an attempt at an explanation of this wonderful fact: it coincides beautifully, however, with the view we are advancing of the static and dynamic attributes of matter; a perfect agreement of fact with explanation.

In further illustration that electricity is the dynamic development of matter, we cite the effect of associating a piece of soft iron with a helix, as given by Mr. Faraday, Expm. Researches, Art. 2,441:

"It is very striking to observe the feeble condition of a helix when alone, and the astounding force which

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* Mr. Farraday says, Art. 853, "That this necessary quantity of electricity (belonging to a grain of water) is equal to a very powerful flash of lightning." In the electric decomposition of a grain of water, the water disappears, and in lieu thereof we have oxygen and hydrogen. The result of the decomposing action of the electric current is not to develope electric force, but simply to dissolve the compound substance water into its elements, as the liquid is the static development, no dynamic force (electricity) appears, but that constituting the decomposing current.

in giving and receiving, it manifests by association with a piece of soft iron. So also here we may hope for some analogous development of this element of power, so new as yet to our experience. It cannot for a moment be supposed that being given to natural bodies, it is either superfluous or insufficient or unnecessary. It doubtless has its appointed office and that one which relates to the whole mass of the globe."

If the matter composing the soft iron is not directly involved to a limited extent, how is it that the power of the helix is so vastly augmented by the association? According to our view there is a continued circulation about every magnet; an atmosphere, so to speak; having assumed the dynamic condition, it is impalpable, intangible, invisible. In the case above cited infinitesimal portions of the soft iron beyond doubt assume the dynamic condition, and as quickly return to the static upon the removal of the helix. This effect is of course accomplished by the instantaneous union of the dualities.

In saying infinitesimal portions of the soft iron assume the dynamic condition, we do not mean to say, that it is as matter this condition is assumed, for the dynamic development is no longer matter, but dynamic force (electricity), capable of permeating solid matter with as much facility as the most attenuated. That matter can lose its atomic identity, as it does beyond doubt in the dynamic development, and recover it again upon a union of the dualities, is we are confident a fact. But at present we have not the facilities available for an experimental test.

NATURAL FORCE.

COSMICAL RELATIONS.

To give a complete view of our subject we must consider the Cosmical relations of Static and Dynamic force.

First, in considering static force the question arises, does matter, however attenuated, pervade all space? This is no longer a question of doubt, but an established fact. It is well-known that Professor Encke observed a retardation in the orbital movement of the comet known by his name, and attributed the phenomenon to a resisting medium. Sir Isaac Newton entertained the belief that a medium pervaded space, as he tells us, "that the mere attraction of distant portions of matter is not a sufficient or satisfactory thought for a philosopher; that gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum, without the medium of any thing else, by and through which their action and force may be conveyed from one to another, is a great absurdity; gravity must be caused by an agent acting constantly according to certain laws, but whether this agent be material or immaterial, he leaves to the consideration of his readers."

Thus we perceive as long ago as the day of Sir Isaac Newton this belief in a medium pervading space was established in the mind of the great philosopher. The idea of such a medium being immaterial is long since exploded. How could attenuated matter be immaterial? We may say what we will about *immaterial*, in this connection it can admit of but one interpretation, i. e., that it has no palpable existence; that it is a void, that it is nothing. Such a conclusion would not agree with the fact as observed by Professor Encke and adopted by the whole modern school of philosophers.

In extending our view, as already propounded of static force in its telluric connections, to its cosmical relations, we make no additional speculation beyond this: Static force (matter) we hold pervades all space, attenuated to such a wonderful extent that we can only recognize it by its effects; yet as potent and powerful in its unerring action as the solid matter of our globe.

The countless millions of twinkling stars, which we know to be vast suns, we hold are retained in their respective positions in reference to each other and the whole universe through the medium of this all-pervading force, this matter, which gives to each mighty sphere a source of wonderful power. Witness the numerous binary and tertiary systems of revolving suns that the space-penetrating telescope reveals to our wondering gaze. And this is matter or force, call it either you please, in power and great glory. Imagine two or three vast suns equaling and even surpassing our sun in magnitude and brilliancy, con-

tiguous to each other and moving about each other, a system of revolving suns, the shades of color peculiar to each luminary beautifully contrasting. Such brilliancy, such glory, such mighty power, is entirely beyond finite appreciation!

Gravity as defined by Sir Isaac Newton governs the movements of all the wonderful spheres, unchanging, unvarying gravity. This force of gravity we hold to be static force (matter). To understand and realize the question properly in this connection we must not allow our ideas of matter as we recognize it in our sublunar abode to prejudice our minds; matter to be matter is not necessarily dense, as we behold and recognize it, but may be attenuated to an almost unlimited extent.

To comprehend that the attraction of gravity may be as much a force of matter as any telluric substance, look upon our milky way any bright night, and you behold a vast zone of light, which a telescope of moderate power reveals; an enormous multitude of stars utterly beyond computation. If we look beyond our firmament into space it is evident that an area not exceeding 1-10 of the lunar diameter, contains a system of stars rivaling in number those which constitute our firmament, and appearing only as a single faint luminosity to us; yet there are many so occupied, and the application of a large telescope reveals a vast mass of stars, so closely packed as to rival our firmament in grandeur and extent. Taking a telescopic view of remote firmaments, the presumption that they owe their identity to this attraction of matter is by no means difficult to realize. Yet we

know the stars in these remote nebula are as far removed from each other as our sun from the fixed stars.

As there is no doubt in regard to a medium pervading space, which medium is attenuated matter, it is apparent to our mind that the sun would attract more of this medium to his immediate vicinity owing to his immense bulk, than could be found in more remote regions, and consequently the medium would be more dense in the vicinity of the great luminary than in other sections of space, thereby augmenting the attractive power of the sun upon his planets to an extent that would in a comparatively short period of time prove ruinous to the whole solar system. The orbits of the respective planets, influenced by excessive solar attraction, would rapidly contract until they were all hurled into the mass of the sun, resulting in the total ruin of the solar system.

With earnest inquiry we ask, where and what are the counteracting agents nature has raised up to prevent such a result? Comets loom up before us as the agents we are seeking, the great regulators designed by nature to preserve the integrity of the solar system, and we at once see a design, a cause for that wonderful train of mysterious light. We feel assured that comets are active agents restraining the attractive power of the sun within limits essential to the integrity of the system, acting as they do with wonderful power and energy upon the dense medium about that luminary, and at such time displaying a train of enormous length and great brilliancy as the accumulated matter is projected into space.

The great comet of 1858 was a very interesting and remarkable instance of rapid and energetic action upon its near approach to the sun, or about the period of its perihelion passage:*

"On the 2d of June 1858, a faint nebulosity slowly advancing toward the north was observed by Donati at Florence, near the star ϱ Leonis. This was the earliest observation of the great comet of 1858, its distance from the sun being then about 200 millions of miles, while from the earth it was yet more remote. . . . . Traces of a tail were noticed on the 20th of August, and on the 29th it was seen with the naked eye as a hazy star. . . . . On the 6th of September was first noticed the curvature of the tail. . . . . On the 20th the first series of extraordinary phenomena manifested itself in the region contiguous to the nucleus. . . . . On the 25th four envelopes were seen, and others were subsequently formed, almost under the eye of the observer, the motion of projection from the nucleus being evident from night to night. The rapidity of their formation, and the enormous extent to which they are ultimately expanded, are phenomena exceedingly difficult to explain. The scene of chaotic confusion presented within the innermost envelope can only be accounted for as the result of sudden and violent disruptions from the central body, projecting immense volumes of some substance towards the sun, which by some unknown law is in turn repelled by that body and driven off to distant regions of space,

* Annual of Scientific Discovery, 1859, by Professors Bond and Mitchell.

forming the vast train of light so characteristic of these mysterious bodies."

It must be remembered that Donati estimated this comet to be only a little more than twice the distance of the earth from the sun, when he first observed it at Florence: a faint nebulosity, and in the midst of the solar system really within the orbit of the Asteroids. And yet upon its near approach to the sun we find it assuming magnificent proportions, with energetic and violent action in and about the nucleus, clearly demonstrating that at such time the comet is performing with great vigor the work for which it is designed by nature.

The formation of the envelopes almost under the eye of the observer, their motion of projection from the nucleus, the rapidity of their formation and the enormous extent to which they expand, are all facts full of meaning.

In the next sentence Professor Bond tells us the comet is doing the very work our theory assigns to it, for we must understand that it is acting upon some contiguous material, else whence comes this vast increase of matter, magnitude, brilliancy and power, all within so brief a period of time? And this at the only point in our system where we know the medium might be dense enough to provoke such action, and then the nebulous train that is projected into space with so much power from the action or reaction, as observed in the scene of chaotic confusion within the innermost envelope.

Professor Mitchell of the Cincinnati Observatory says of Donati's comet: "On the 23rd of September

the head of the comet to the naked eye appeared brighter than a star of the first magnitude, and during the remaining period of its visibility, it went through a series of periodic changes, acquiring more light just before an eruption and suddenly diminishing afterwards."

The comet in this case speaks for itself; after Professor Mitchell's admirable description no comment can make it more apparent.

The comet is working with wonderful regularity and great power, else why these periodic eruptions with sudden diminution of light afterwards? The comet is evidently absorbing, or taking up, some contiguous substance or matter, and projecting it into space, thus forming the train or tail that is so striking a feature in every large comet. The nucleus itself is a minute point compared with the immense volume of light-giving substance of which it is the controling centre.

"The comet of 1858 undoubtedly takes a foremost rank in respect to the multiplied and most curious changes which it has exhibited, and especially in the complete illustration which it affords of the origin and construction and final dissipation of a succession of envelopes. *In these phenomena the process of the formation of the tail, from the substance in immediate contact with the nucleus is intimately concerned.*

"The astronomer night by night sees the work of evolution going on with amazing rapidity, and seemingly in defiance of the best established properties of matter, the laws of gravitation and inertia. The results are evident to all, but the secret cause is a

profound mystery admirably calculated to stimulate speculation and intelligent investigation." What further argument can we advance? A distinguished astronomer tells us, he has seen this comet night by night performing the very work our theory assigns to it, and that the evolution went on with amazing rapidity and in defiance of the best established properties of matter. This comet no doubt did its work well, or it was near enough to our planet to be intelligently observed.

The object, the province, the office of a comet, is to act in direct opposition to the attractive power of the sun, as we have already fully stated.

A writer alluding to the comet of 1807, says, "It was assiduously observed by Herschel in this country (England) and by the continental astronomers Schroeter, Bessel and Olbers; the drawings of the two former on two succeeding evenings show a divided tail, the separate branches having varied their aspects. *Corruscations flickering and vanishing like the northern lights, appeared to shoot out in an instant from the train to an immense extent.*"

The comet of 1744 excited great attention and interest. No train being visible until the comet was within the orbit of Mars, when it appeared with a tail divided into six branches, all diverging but curved in the same direction.

It appears from the above facts that comets perform their office with one or more tails, as we are told that of 1744 presented no less than six. The corruscations observed in the tails of the comet of 1807 are very striking and suggestive.

The brilliant comet of July 1861, was first noticed at New Haven on the 30th of June, and in Europe on the same evening. It was remarkably brilliant when first seen, with a nucleus brighter than a star of the first magnitude. Professor Bond says, "the tail was a narrow straight ray projected to a distance of 106 degrees." Its excessive brilliancy was owing to its nearness to the earth, as it was not more than thirteen million of miles distant when first seen.

The most remarkable feature of this comet was its sudden and brilliant apparition, and that so near our earth; why it was not earlier observed, is certainly very curious. It must have been near our earth for some time previous to the first observation, but the nucleus did not provoke sufficient action prior to that date to render the comet visible.

The trains of all comets, as far as we can learn, are invariably projected in a direction opposed to the sun, whether the comet is approaching or receding from that luminary. We are told that this is not invariably the case, but are yet to learn the first instance to the contrary, unless the annexed remarks by Mr. Bond could be thus construed. Speaking of the appearance of Encke's comet in the latter part of 1861, he says:

"Its most interesting peculiarity was a very decided disposition of its nebulosity on the side towards the sun, constituting a faint tail as it were opposed to the normal direction. This was formed a long time before the true tail made its appearance. It is by no means a new feature, as it is mentioned in its preceding apparitions by Struve, Schwabe, Wichman

and others. In 1848, and again in 1852, it was particularly evident. The fact of its repetition in so many instances gives a kind of individuality to this comet, distinguishing it from most bodies of its class, and is interesting from its associations with its otherwise very remarkable character."

Mr. Bond speaks of the normal direction and the true tail, which is equivalent to telling us the nebulous protrusion in the direction of the sun was not the tail, as he also tells us the true tail subsequently made its appearance.

The separation of Biela's comet into two parts, forming two perfect comets with tails appended, in January 1846, was very interesting and curious, and has particular bearing upon our theory, indicating the dynamic condition, electric action.

While treating upon the Cosmical relations of this theory, we must not pass over in silence the source and origin of the

AURORA.

The beautiful and interesting phenomena of the Aurora Borealis and Aurora Australis that enliven our polar regions, are explained by this theory in the most complete and satisfactory manner. We know the orbicular motion of our globe to be rapid and regular, at the same time we are well aware that the diurnal or rotary motion is also regular and about a thousand miles an hour at the equator, decreasing as we approach the northern and southern poles until at the latter points we find really no diurnal motion.

As our earth in this orbicular and rotary motion

is moving through a medium, some displacement of this medium must occur; it must as it were slide off in or about the respective polar regions. This sliding off from the earth cannot be at the actual poles, but from the rotundity of our globe would be most likely to occur about the sixtieth or sixty-fifth degree of latitude.

In permeating our atmosphere as this medium unquestionably does, being at the same time subject to the action of the sun, the dynamic characteristic is to a greater or less extent developed; i. e., is rendered evident in its passage from the earth, in the beautiful coruscations and scintillations that are so prominent a feature in our polar and [illegible] temperate regions.

Apart from appearances, which have always inclined us to believe the aurora electric, evidences of its electric origin are strongly indicated upon the recurrence of every auroral display. The telegraph at different sections in our country has been frequently so much affected by auroral electricity as to find it advisable with the north and south lines to cut off the batteries, and operate solely with the auroral current.

A writer in the *Annual of Scientific Discovery*, 1860, says: "It appears from the observation of the telegraph operators, that while the lights are streaming up the heavens there are strong electric or electromagnetic currents passing over the surface of the earth, which according to a writer in the *Atlantic Magazine*, December 1859, are frequently equal in strength to a current produced by a battery of two

hundred Grove's cups. These follow the telegraphic wires wherever they encounter them, and the observations made upon their influence during the recent auroral displays show that the earth currents pass in waves, alternately negative and positive. First comes a strong wave of positive electricity, which gradually subsides, and is succeeded by a negative wave. The average duration of each wave is about fifteen seconds." These facts, with others that might be readily adduced, are conclusive proof that the aurora is entirely electric.